

## Full Surface Interferometric Testing of Grazing Incidence Mirrors

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Abstract: This research is in the initial stage of testing, designing, and constructing a scanning shearing interferometer breadboard for measuring the full surface figure and macroroughness of cylindrical and toroidal aspheric grazing incidence mirrors. This approach using normal incidence subaperture shearing interferometry combines high measuring accuracy and measuring speed with low sensitivity to environmental disturbances. Past approaches used a) full aperture interferometry at grazing incidence, which results in very small beam cross section and low accuracy and b) pointwise interferometry with a long trace profiler, which is too slow and too sensitive to environmental disturbances for full surface scanning.

To achieve this goal a cylindrical beam shearing interferometer is used to measure the mirror figure over a series of extended, overlapping subapertures, then the full surface figure is synthesized in software.

- \* The use of a shearing interferometer assures a high degree of immunity from vibration and turbulence, while providing a high precision slope measurement at normal incidence.
- \* The use of extended overlapping subapertures permits unambiguous matching of the discrete measurements by least square and other techniques, independent of scanning imperfections.
- \* The high precision of measurement and synthesis are made possible by the use of digital, phase measuring interferometry techniques. The software operations include phase measurement of x and y slope subaperture interferograms, wavefront reconstruction by numerical integration and wavefront synthesis from subaperture interferograms.

The anticipated payoff of this research are in the development of grazing incidence optical components for X-ray and UV lithography, medical diagnostic imaging, and optical testing (metrology).

Diagram 1 shows a detailed layout of the interferometer breadboard used to carry out the proof of principle. The subaperture scanning will be implemented manually. The breadboard system is described in terms of the following modules:

- \* Source module which includes a low power HeNe laser and auxiliary optics including a spatial filter for beam clean up and expansion as well as a telescopic lens system L1 and L2.
- \* Shearing interferometer polarization module using either crystal optics or a grating, using a translatable Ronchi and specially produced sinusoidal rulings.

Diagram 2 describes the complete breadboard system and relationship of the optical head to the scanning surface and folding mirror.

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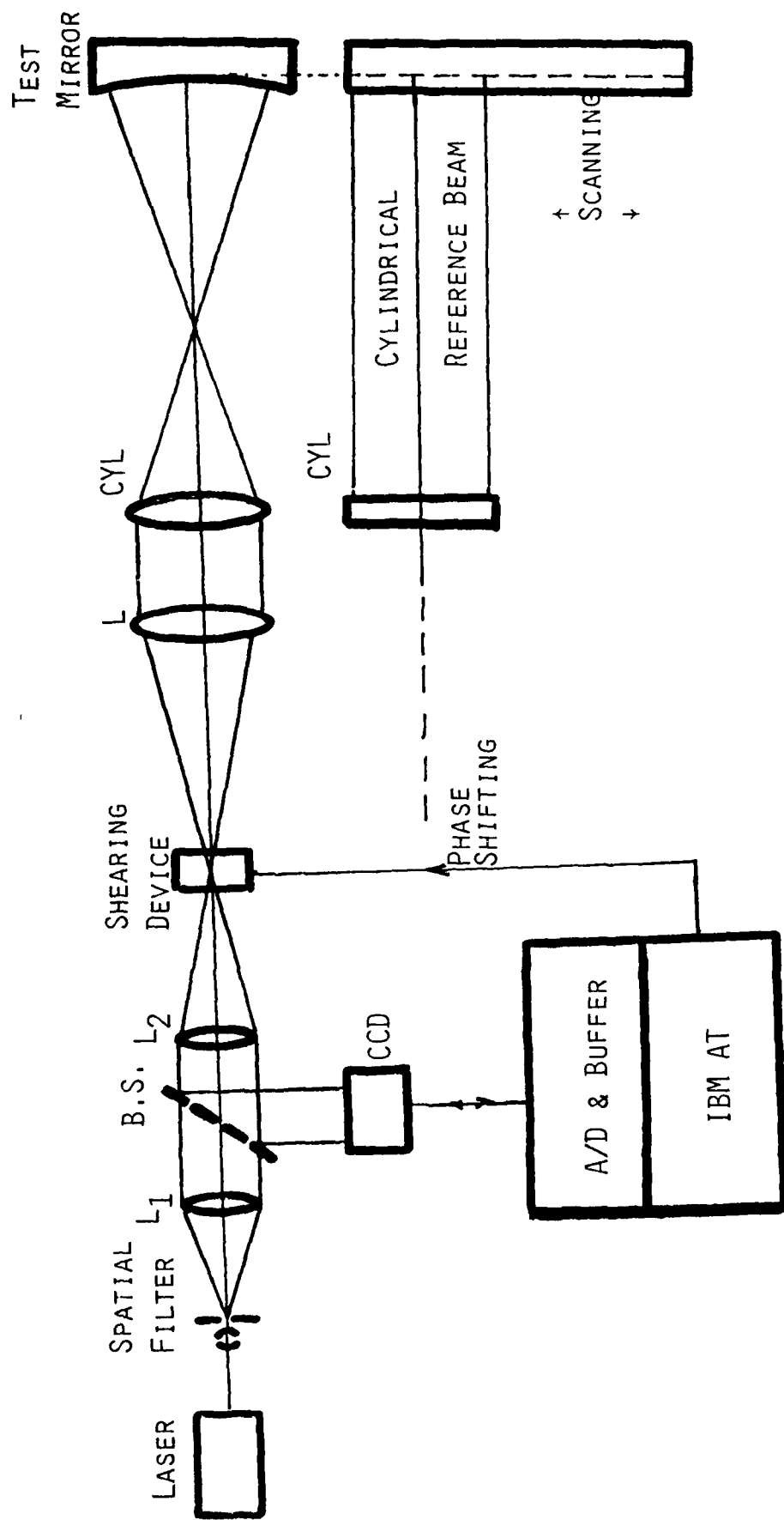


FIGURE 1: DIAGRAM OF INTERFEROMETER HEAD

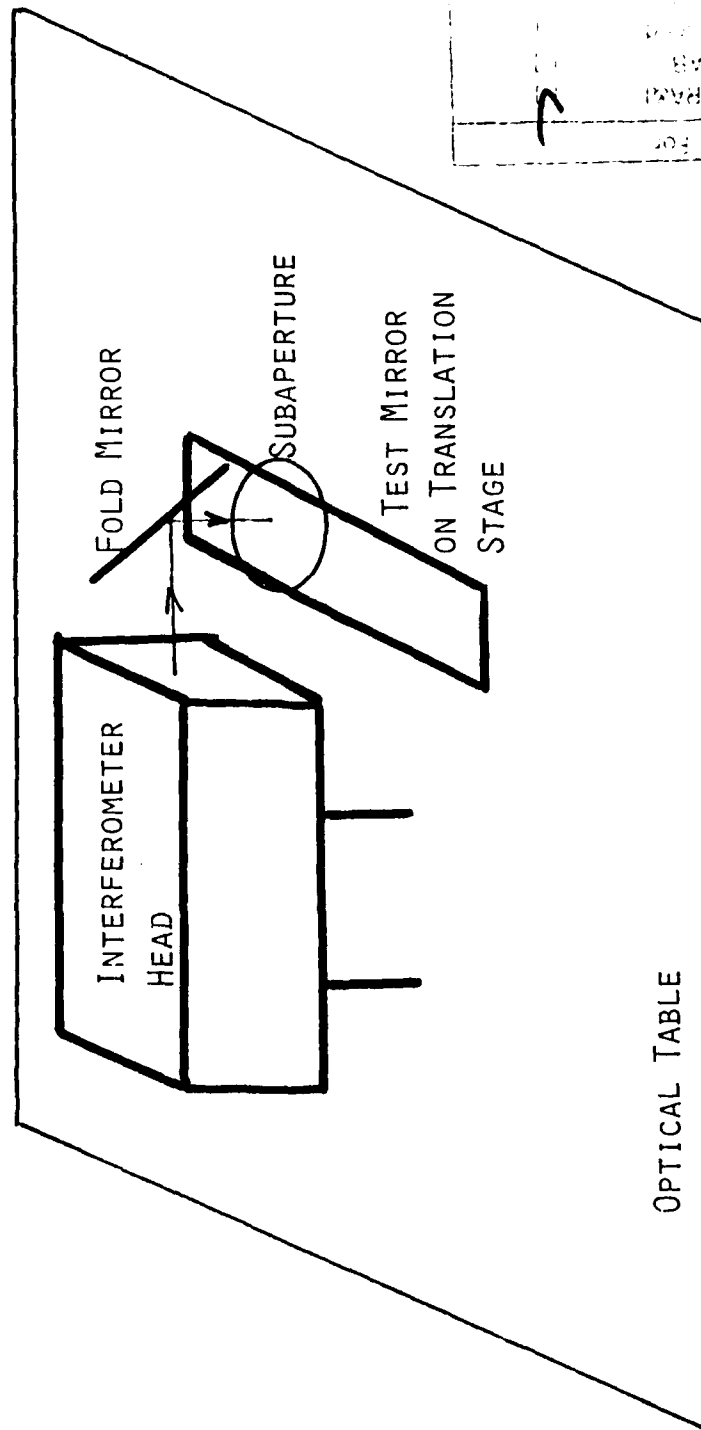


FIGURE 2: DIAGRAM OF COMPLETE BREADBOARD SYSTEM

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